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AUTHOR Abramovitch, L. I.; Marvin, R. S.
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ABSTRACT

This study was concerned with age changes in the size of repertoire, rate of display, and complexity of facial expressions in preschool children. Nine children in each of the age groups, 3-3 1/2, 4-4 1/2, and 5-5 1/2 years, were videotaped as they participated in free play (without formal supervision) on their nursery school playground. The samples were viewed in the laboratory and facial behavior was scored by using a modification of Blurton Jones' catalogue, which consisted of 50 categories of facial elements of children. Results indicated that between the ages of 3 and 5 years children showed an increase in the size of repertoire, rate of display, and complexity of facial expressions. Facial expressions were also more predictable in younger than in older children. Children at all ages used only about 25% of the total possible number of combinations of facial elements, though younger children tended to display "neutral" facial expressions more often than older children. In general, the results of the study indicated that the potentially available social information in facial expressions increases with age. (Author/SB)

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FACIAL EXPRESSION IN PRESCHOOL CHILDREN

L. I. Abramovitch and R. S. Marvin

University of Virginia

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INTRODUCTION

In the last 100 years, ethological methods of investigation have been widely used in the study of animal social behavio It is only in the last eight to ten years, however, that this methodology has been applied to humans. Tracing the history of research on human facial expression, Blurton Jones (1972) noted that the work of Grant (1969), Eibl-Eibesfeldt (1970), and others was an extension of the studies of primate facial expression by van Hooff (1962) and Andrew (1963). This work in turn drew on the methodology used by Tinbergen (1959) and Hinde (1956) in their studies of bird displays. Thus the ethological study of human behavior is a logical and historical extension of animal ethology.

Ethological methods depend heavily on descriptions of characteristic behavior patterns used by a species. Early investigations of children's facial expression (e.g., Ames 1949, Washburn 1929) did not present detailed descriptions of the facial behavior that they studied. Rather, as Charlesworth and Kreutzer (1973) have pointed out, these studies dealt mostly with the frequencies of different facial expressions and with the environments in which these different expressions occurred. The 'morphology' of child facial expression has been described in detail only in the more recent ethological studies.

One result of this recent emphasis on the morphology of behavior has been the development of checklists of the basic

elements of human facial expression. In these checklists, facial elements are identified and described explicitly and in detail. Facial elements refer to single items such as "upper teeth showing". The flow of facial elements constitutes facial behavior. Facial expressions, on the other hand, are relatively static positions of the whole face which result from the slicing up of facial behavior. Grant (1969), Brannigan and Humphries (1 and Blurton Jones (1971) have independently constructed largely similar checklists of facial elements. Thus far, however, few systematic quantitative studies have been carried out using these category systems.

Recently, Blurton Jones (1972) has concluded that the development of facial expression in children is comparatively complete by about age two. His conclusions are in agreement with current notions that certain facial expressions in humans are innate (Darwin, 1872; Eibl-Eibesfeldt, 1970; Ekman, 1969; contra Birdwhistle, 1970). However, subjective impressions and everyday experience indicate that children's facial communication is different from that of adults. In addition, since social development is not complete until much later than two years, the functioning of facial expression in social interaction might be expected to change along with changes in other social behavior. Although the total number of facial elements used by a child may not change after two years of age, there may be changes in how these <u>elements</u> are grouped into facial <u>expressions</u>, (Marvin & Abramovitch, 1974), in how frequently each

element or expression is used in various social situations, and in the degree of voluntary control of facial expressions (Ekman, 1972).

In a preliminary study of "coy" behavior, Marvin and Abramovitch (1974) found that the maximum number of co-occurring elements of a characteristic coy facial expression increased from the ages three through five. The present study sought to discover if similar developmental changes in facial behavior were present in other facial expressions.

More specifically, this study was concerned with age changes in the co-occurrence of facial elements in preschool children. The primary research questions were: (a) do children of different ages differ in the frequency with which they display facial elements; (b) do children of different ages vary in the likelihood with which they combine various elements into facial expressions; and (c) are there age differences in the predictability or amount of information inherent in facial expressions. It was expected that systematic increases with age would be found in: (a) the mean number of elements displayed in an expression (complexity of the expression); (b) the predictability of the co-occurrence of certain elements; (c) the number of different facial expressions displayed, and (d) the rate of display of facial expressions of all kinds. Additionally, it was hypothesized that the differences in amount of time spent by each age group in social as opposed to solitary situations would not in itself account for the observed pattern of change in facial behavior.

METHODS

Subjects and Location

The subjects studied were pre-school children at a nursery school in Charlottesville, Va. Nine children in each of the age groups, 3-3½, 4-4½, and 5-5½ years, were videotaped as they participated in free play on the school playground. // "Free play" occurred when all the children at the nursery were brought onto the playground and left without any formal supervision. The teachers merely looked on, but did not intervene unless someone was hurt or unless approached by a child. Generally, two hours of free play occurred each day, one hour in the late morning and another hour in the mid-afternoon.

Behavior Sampling Methods

Data were collected primarily on video-tape. In order to accustom the children to the camera, five sessions of sham-taping were conducted before actual data collection was begun. In an actual taping session, two minutes of continuous samples of facial expressions of a single child, the focal individual, were collected. The order of children sampled was determined from a random number table. All the children of a single age group were sampled on each day; hence each age group was sampled once every three days. The total data collected on each age group was eight sample-days. Each sample-day consisted of 18 minutes of videotaping; two minutes per child.

Each two minute sample period was timed with an electronic timer. During each sample period, the zoom lens of the video camera was used to allow the focal child's face to fill as much of the viewer as possible; this was usually done from a distance of about 10 feet. If the focal child ran or walked during the filming, the camera operator ran as well, while continuing to tape the focal child's face. This method was essentially a modification of the focal animal sample technique described by Altmann (1974). These focal samples were subsequently used to calculate rates of behavior. Although it was assumed that the behavior recorded was essentially a random sample of children's facial behavior, several possible biases are described in the section on scoring procedure.

Additionally, a rough categorization of the child's behavior as "social", "semi-social", or "solitary" was recorded on the audio portion of the video tape. A focal child was categorized as solitary if there were no other individuals within approximately 10 feet of him, and if he was not obviously interacting with anyone else, (e.g., shouting, waving, etc.) If the focal child was within 10 feet of another individual, but not obviously interacting with him he was categorized as semi-social. Finally, a child was categorized as social if he was obviously interacting with another child or the teacher no matter how far away that other person was located. The videotaped focal samples and context codes were later collated so that each facial expression was coded as occurring within one of the three social contexts.

Focal sampling started and concluded independently of the focal child's behavior. The first and last social context code for each child at each session constituted 'instantaneous' scans of the child's behavior and were later used to estimate proportions of time spent in each social state (c.f., Altmann, 1974)

Definition and Scoring of Behavior

The samples were subsequently viewed in the laboratory and facial behavior scored (or coded) by using a modification of Blurton Jones' (1971) catalogue. The catalogue consists of fifty categories of the facial elements of children and includes as its main segments, positions of eyebrows, eye positions, shape of lips, lip separation positions with respect to tooth exposure, positions of tongue, and several other categories. A detailed description is presented in Appendix A.

After several preliminary coding trials, it became evident that coding for every change in eye direction would involve too many codings and consequently this category was eliminated. One additional category in the lip position segment was found to be needed. Also, the hair of both boys and girls often obscured the position of the eyebrows; consequently, only a small sample of eyebrow positions was obtained, and these data were also deleted from analysis.

Coding involved a frame-by-frame examination of the video tape. The flow of facial behavior was broken up into apexes of movement in a manner analogous to Ekman (1971). At each of these

apexes, a coding of all facial elements present on the face was entered in the data record. For example, a coding of degree of mouth openness was not made until the movement of the opening reached its fullest degree of extension. As a convention, if apexes of different elements occurred within .5 second of each other, then only a single coding was made. If different elements apexed further apart in time than .5 second, then the entire face was coded separately for each apex.

Several other scoring conventions were also established. For example, the face was not coded if the child was talking, eating, covering the face, or sucking his thumb. In addition, if the picture was blurred or if only a profile of the face was visible on the screen, the segment was eliminated from the data analysis. Since these conditions occurred between 74 and 86% of the time, the actual sequence of coded behavior contained a number of breaks in continuity. These breaks in continuity were also recorded on the coding sheet. Since blurred pictures were often produced by running, many tapes involving active movement were not codable. If a child spent the entire two minutes running, eating, etc., so that it was impossible to score any codes, that sample was eliminated from the data. Therefore, the results of this study were probably biased against facial behavior during running, jerky movements, and other active conditions.

For purposes of comparison across age groups, a large number of facial expressions was required. As discussed later, approximately 800 codable expressions were collected for each age group.

Observer Agreement

Interobserver agreement was measured by comparing the coding of two independent scorers on 100 separate expressions. A measure of agreement was obtained by dividing the number of agreements by the total number of codings, and equaled .76 in this study. Two independent scorers of social context obtained a .92 agreement.

RESULTS AND DISCUSSION

Total Time and Number of Codes

Although eight sample-days were collected for each age group, machine failure forced termination of coding prematurely. At termination, seven sample-days had been coded for the three- and four-year olds, and five sample-days for the five-year olds. Table 1 presents the total number of facial expression coded for each age group, as well as the mean codable time per sample-day. The term "codable time" refers to that time during which the focal child's face was sufficiently visible to allow scoring of facial behavior. The conditions referred to previously, such as running, eating, blurred picture, etc., accounted for the noncoded time. The percent of codable time per sample day decreased with age. The total number of codes was approximately 800 for each age group. Altogether it required 240 hours to code the data.

The total number of codes divided by the total codable time provided an estimate of the rate of facial expression for each age group. As predicted, the overall rate of facial expression increased from 3 through 5 years of age. The rate for the three-year olds was approximately one expression every 2.4 seconds; the rate for the five-year olds was approximately one expression every second. However, the younger children tended to be relatively more solitary than the older children. Perhaps, these differences in rates of behavior were due to differing amounts of time spent in different social contexts rather than to age related or maturation

Table 1

Total Number of Codes and Overall Rate of Facial Expression as a Function of Age Group

Age	Total number of codes	Mean codable time per sample day in min. (% of total taping time)	Overall rate (codes/min.)
3	827	4.7 (26%)	24.98
4	862	3.4 (18%)	35.72
5	788	2.5 (14%)	61.95

factors *per se*. To answer this question it was necessary to first estimate age differences in amount of time spent in each social context.

Proportion of Time Spent in Each Social Context

The proportion of time that each age group spent in each context--solitary, semi-social, or social--was estimated from the instantaneous samples. The context that the child was in at the beginning and end of each sample was recorded. The proportion of samples that a child was in each of these contexts yielded an unbiased estimate of the proportion of time spent by that child in each context (Altmann, 1974). The mean proportion of time for each age group in each social context was then determined. These data are presented in Table 2.

From Table 2 it is apparent that all three age groups spent about 50% of their time in a semi-social context. The three-year olds were solitary 35% of the time, while the five-year olds spent less than 10% of their time in a solitary context. Conversely, the three-year olds were social only 20% of the time, whereas the five-year olds were social over 40% of the time. In each case the four-year olds fell somewhere in between the three and five-year old children. Thus the three-year olds proved to be significantly more solitary than the two older age groups ($t(25)=3.4$, $p<.01$); while the five-year olds were significantly more social than the two younger age groups ($t(25)=2.6$, $p<.02$).

Table 2

Mean Proportion and Standard Deviation of Time Spent by each Age Group in each Social Context[a]

Age	Solitary	Semi-social	Social
3	.35 (.15)	.45 (.24)	.20 (.16)
4	.17 (.19)	.55 (.20)	.28 (.19)
5	.08 (.10)	.49 (.13)	.42 (.18)

[a]Numbers in parentheses indicate standard deviations.

For each age group, within subject t-tests were performed on the differences in the amount of time spent in each context. For the three-year olds there was no significant difference in the amount of time spent in solitary and in semi-social contexts ($t(8)=.8$, $p<.6$), while differences between semi-social and social approached significance ($t(8)=2.0$, $p<.08$). The five-year olds, on the other hand, did not differ significantly in the amount of time spent in social and semi-social contexts ($t(8)=.7$, $p<.5$), while they differed significantly in the semi-social and in solitary contexts ($t(8)=8.6$, $p<.01$). The four-year olds differed significantly in the amount of time spent in solitary and semi-social contexts ($t(8)=3.3$, $p<.01$), and in semi-social and social contexts ($t(8)=2.4$, $p<.05$).

These results indicate that the three-year olds "minimized" the amount of time spent in the social context, while alternating between the semi-social and the solitary contexts. The five-year olds "minimized" the amount of time spent in the solitary context, while alternating between the semi-social and the social contexts. The four-year olds constituted an intermediary case: they avoided being solitary (but not as much as the five-year olds), and they minimized the amount of time spent in the social context. These findings are consistent with the age differences found in other studies of social participation and play of preschool children (Iwanaga, 1973; Parten, 1933; Parten & Newhall, 1943).

Table 3 presents the raw frequencies from the instantaneous samples of social context. Row totals reflected the total number of samples minus those samples which were entirely non-codable.

A one-sample Chi-square test on the frequencies in Table 3 indicated that time in social context was not independent of age ($\chi^2_{(4)}=23.3$, $p < .01$). The three-year olds spent much more time than expected in a solitary context, and much less time than expected in a social context; conversely, five-year olds spent much less time than expected in a solitary context, and much more time than expected in a social context. All age groups spent roughly the amount of time expected in a semi-social context.

Rates of Expression and Social Context

It was now possible to determine if the differences found in overall rates of facial expression were due to the tendency of the younger children to be more solitary and less social than the older children. Table 4 presents the age specific rates of facial expression for each social context. These values were determined by dividing the number of codings for each context by the corresponding amounts of time spent in that context as estimated from the instantaneous scans. The results show that the three-year olds had lower rates of expression than the four-year olds in both the solitary and social contexts. The four-year

Table 3

Frequencies of Instantaneous Time Sampling as a Function of Age and Social Context

	Context			
Age	Solitary	Semi-social	Social	
3	41	59	24	124
4	16	51	29	96
5	7	42	33	82
	64	152	86	N=302

Table 4

Estimated Rate of Facial Expression as a Function of Age Group and Context

Group	Total time (estimated minutes)	Number of codes	Rate in codes/minute
Age 3			
solitary	11.6	205	17.7
semisocial	14.9	452	30.3
social	6.6	170	25.7
Age 4			
solitary	4.1	200	48.8
semisocial	13.2	407	30.7
social	6.7	255	37.7
Age 5			
solitary	1.0	72	70.6
semisocial	6.2	374	60.6
social	5.3	342	64.0

olds, in turn, had uniformly lower rates than did the five-year old children in all contexts. This indicates that the age differences in rates of facial expressions was not due to amount of time spent in particular social contexts.

Age differences in Repertoire of Facial Expressions

In this investigation, a facial expression was counted as different from another expression, if the two differed in at least one element. Table 5 presents the number of distinct facial expressions as a function of age group. Table 5 indicates that the number of distinct facial expressions increased from three to four, and from four to five years of age. The five-year olds showed 239 different facial expressions; the three-year olds showed 177 different expressions. Similar age differences were found in the ratios of number of distinct expressions to total number of expressions. This indicated that the size of the repertoire varied with age rather than merely reflecti differences in the number of coded expressions at each age. In addition, no expression occurred at a younger age which was not also found present at an older age. It is noteworthy that no more than 25% of all the physically possible facial expressions were shown by the children in this study.

Percentage of Repertoire Accounted for

In studying the behavioral repertoire of rhesus monkey (Macaca mulatta), Altmann (1965) noted that a few behavior

Table 5

Number of Distinct Facial Expressions as a Function of Age

Age	Number of distinct expressions	Ratio of No. distinct expressions/ Total No. of expressions
3	177	.21
4	204	.24
5	239	.31

patterns accounted for a relatively large proportion of the total number of behaviors ever displayed. Similar results with respect to facial expressions were found in this study. Figure 1 presents the cumulative percent of facial expression relative to their rank order of occurrence. For the three-year olds, eight different expressions were sufficient to account for 50% of all facial expressions; eleven expressions were required for 50% of the behavior of the four-year olds, and seventeen expressions were required for the five-year olds. Table 6 presents a calculation of Shannon's (1948) H(X)--mean amount of uncertainty--for the expressions making up 50% of the coded behavior. The results indicated that the 'uncertainty' of the five-year olds' facial behavior was approximately twice that of the three-year olds.

Most Frequent Expressions

Table 7 presents the ten most frequently occurring facial expressions for each age group. Seven of these were identical for each age group. Three other expressions were among the ten most frequent for two of the age groups. These findings suggest a remarkable degree of continuity across these age groups. The most commonly occurring four or five expressions, however, were used much more frequently by the younger children than by the older children (c.f. Figure 1).

From Table 7, it is apparent that the two most frequently occurring expressions at all ages were: mouth closed, no teeth,

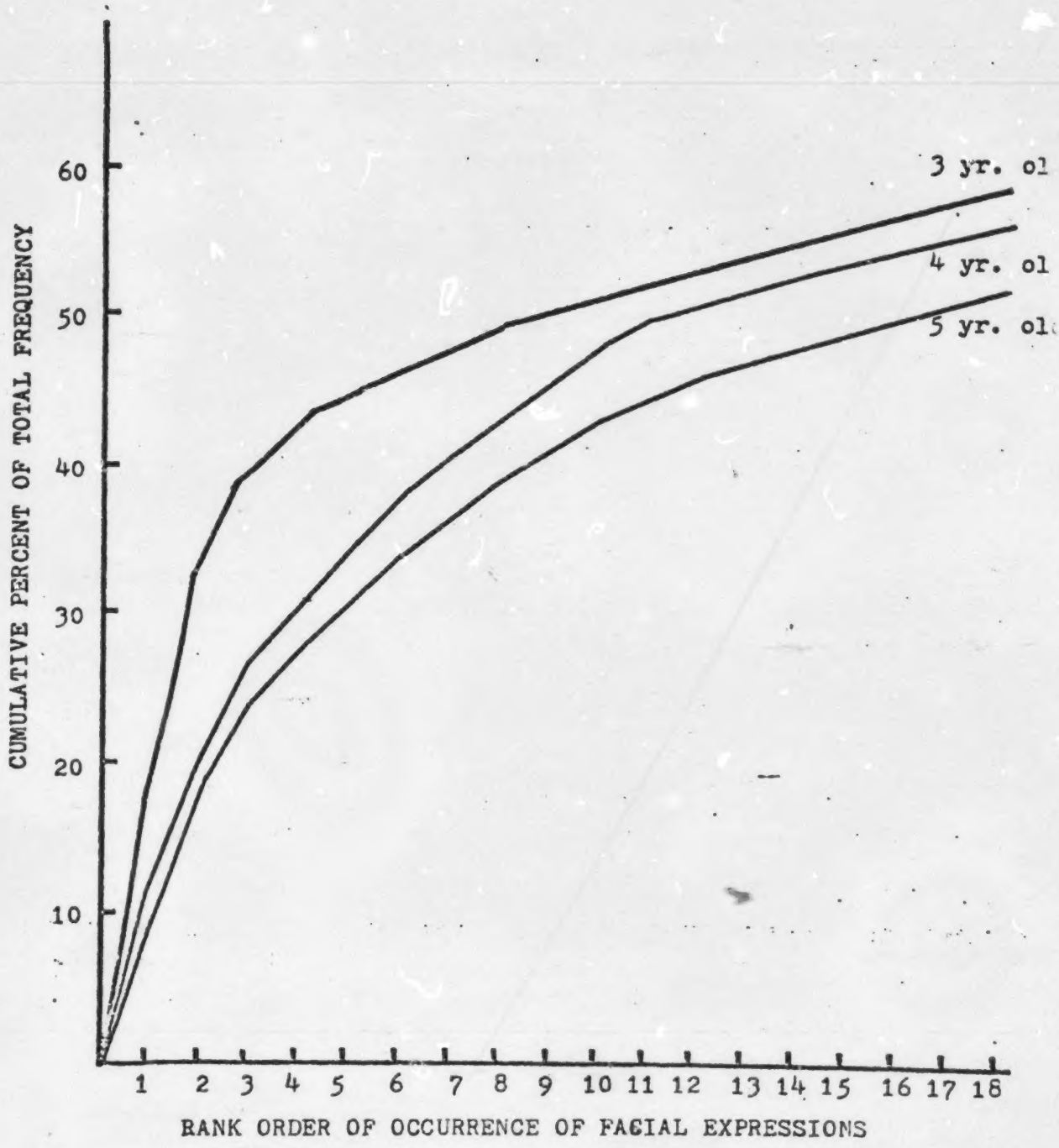


Figure 1. Cumulative percent of facial expressions relative to their rank order of occurrence.

Table 6

Shannon's Uncertainty Measure, H(X), for 50% of all Facial Expressions at each Age

Age	H(X)
3	.10
4	.19
5	.22

no tongue, jaw closed; and mouth slightly open, no teeth, no tongue, jaw closed. In addition, lips closed, corners pursed, was the third most frequently occurring expression for the three and four-year olds; it was the fourth most frequent for the five-year olds. These three highly frequent expressions are relatively "neutral" in appearance, and were much more frequent in the younger children than in the older children. In addition, these three expressions alone accounted for 40% of all the three-year olds facial behavior, 27% of all the four-year olds behavior, and 24% of all the five-year olds facial behavior. At any given moment therefore, the younger children were more likely than the older children to proceed from one facial expression to a 'neutral' expression. This finding parallels casual observations that younger children do not engage in as much prolonged social interaction as older children, and seem to be 'neutral' much of the time.

Other frequently occurring expressions included: (a) smiles, any expression with corners raised, (b) slightly open lips, no tongue, upper teeth showing, (c) mouth closed, no teeth, no tongue, jaw closed, lips pressed together, and (d) mouth closed, no teeth, no tongue, jaw closed, lips retracted. (Table 7). According to Grant's (1969) motivational analysis of the face, the most frequent expressions at all ages would be classed as social greeting (a, above), aggressive display (c, above), and flight reaction (d, above). These results are probably representative only of those activities during which it was possible

Table 7a

Frequency of the Ten Most Commonly Occurring Facial Expressions for Age Three

Age 3

Frequency	151	120	55	32
Coded Expression	no teeth no tongue lips sl. open jaw closed	no teeth no tongue lips closed jaw closed	no teeth no tongue lips closed jaw closed corners pursed	upper teeth no tongue lips sl. open jaw closed

Frequency	17	13	13	13
Coded Expression	no teeth no tongue lips closed lower lip covering upper	upper teeth no tongue lips sl. open jaw closed corners raised	no teeth no tongue lips closed jaw closed lips pressed	no teeth no tongue lips closed jaw closed lips retracted

Frequency	12	11
Coded Expression	both teeth lips clearly no tongue jaw closed	upper teeth lips clearly no tongue jaw closed corners raised

Table 7b

Frequency of the Ten Most Commonly Occurring Facial Expressions for Age Four

Age 4

Frequency	97	82	60	30
Coded Expression	no teeth no tongue lips closed jaw closed	no teeth no tongue lips sl. open jaw closed	no teeth no tongue lips closed jaw closed corners pursed	upper teeth no tongue lips sl. open jaw closed

Frequency	29	27	27	25
Coded Expression	upper teeth no tongue lips clearly jaw closed corners raised	upper teeth no tongue lips sl. open jaw closed corners raised	no teeth no tongue lips closed lower lip covering upper	no teeth no tongue lips closed jaw closed lips rolled in

Frequency	22	20
Coded Expression	no teeth no tongue lips closed jaw closed lips retracted	upper teeth no tongue lips clearly jaw sl. open corners raised

Table 7c

Frequency of the Ten Most Commonly Occurring Facial Expressions for Age Five

Age 5

Frequency	78	76	39	33
Coded Expression	no teeth no tongue lips sl. open jaw closed	no teeth no tongue lips closed jaw closed	no teeth no tongue lips closed jaw closed lips rolled in	no teeth no tongue lips closed jaw closed corners pursed

Frequency	26	19	19	18
Coded Expression	no teeth no tongue lips closed lower lip covering upper	upper teeth no tongue lips sl. open jaw closed corners raised	no teeth no tongue lips closed jaw closed lips pressed	no teeth no tongue lips closed jaw closed corners raised

Frequency	16	15
Coded Expression	upper teeth no tongue lips sl. open jaw closed	upper teeth no tongue lips clearly jaw closed corners raised

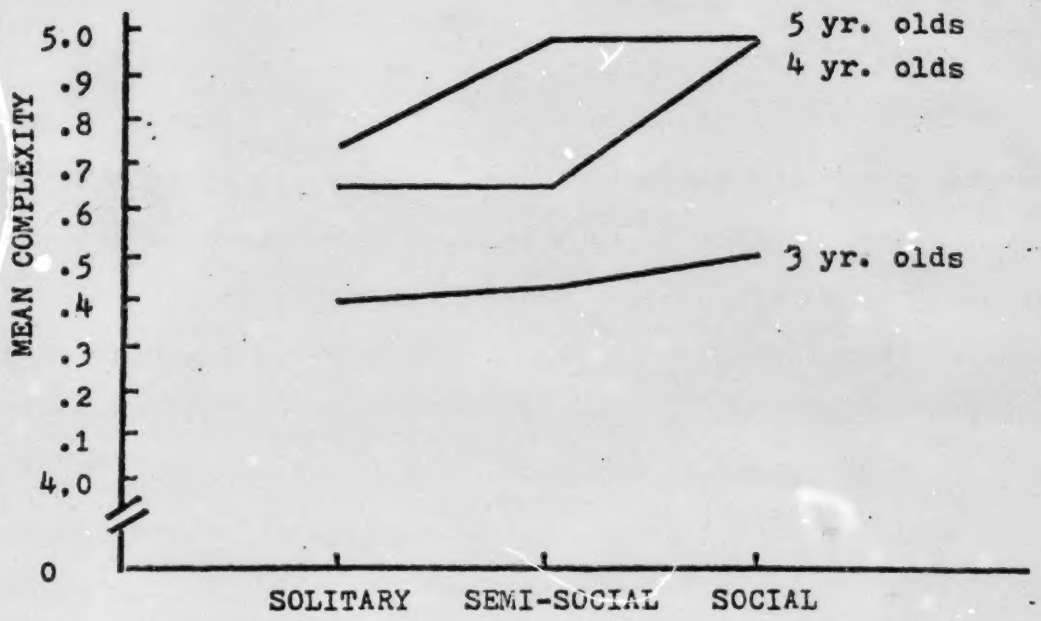
to code expressions. The motivational states during, for example, running were under-represented in this study.

Complexity of Expressions

The number of co-occurring elements in a facial expression can be taken as a measure of the "complexity" of that expression. Thus, complexity in this study was viewed as a physical property of an expression rather than one of its stimulus properties. The lowest possible complexity value of an expression was four (i.e., four elements). The highest observed complexity value was nine, but it was seen on only one occasion (in a five-year old). Figure 2 presents mean complexity values for each age group and context. As hypothesized, these values increased from ages three to five. The complexity measures were determined for 72 randomly chosen facial expressions for each age and context. A Kruskall-Wallis analysis of variance by ranks was performed on these data. The results indicated that there were significant differences in complexity due to age, ($H=472$, $p<.01$) social context, ($H=447$, $p<.01$) and an interaction between age and social context ($H=800$, $p<.01$) (see Bradley 1968, p. 140). Specifically there was an increase in complexity values with increasing age. Complexity also increased from solitary through social contexts. Interestingly, the three-year olds displayed uniformly low complexity values in all social contexts, though the facial expressions of the four and five-year olds were significantly more complex in the social than in the solitary context ($Z=23.4$, $p<.01$, $Z=17.7$, $p<.01$; Wilcoxon approximation of the

Figure 2

Mean complexity measures for each age group and context



normal distribution). In addition, the four and five-year olds differed from each other in complexity only in the semi-social context ($Z=28$, $p<.01$) (see Figure 2).

Smiles

Although the complexity values of the three-year olds did not increase in the social context, other socially appropriate differences in their behavior did occur in this context. Table 8 presents the frequency of smiling (any expression with corners raised) for each age and context. A one way Chi-square test of context was performed on each age group. Expected frequencies were based on the proportion of time spent in each context. For the three-year olds, the largest deviation from expectation was due to greater than expected frequency of smiling in the social context. A similar pattern was found for the two other age groups. Thus, the fact that the three-year olds displayed expressions of similar complexity in all three social contexts did not imply that their facial behavior was constant across those contexts.

Table 8

Frequencies for each Age Group's Smiles in each Context and Resultant Chi-square Values

Age 3	Solitary	Semi-social	Social	
Observed frequencies	16	44	61	
Expected frequencies	42.35	55.46	24.2	
				$\chi^2_{(2)}=74.7$
Age 4				
Observed frequencies	18	51	117	
Expected frequencies	31.62	102.3	52.1	
				$\chi^2_{(2)}=112.$
Age 5				
Observed frequencies	6	37	110	
Expected frequencies	12.2	75.0	64.3	
				$\chi^2_{(2)}=55.($

Note: calculation of chi-square values were based on the assumption that expected frequencies should be proportional to the amount of time spent in the corresponding context.

CONCLUSION

Three hypotheses were confirmed in this study. It was concluded that between the ages of three and five years there was an increase in the size of repertoire, rate of display, and complexity of facial expressions. Facial expressions were also more predictable in younger than in older children, i.e., the younger children tended to display fewer different expressions and to distribute their displays more often over a smaller proportion of their total repertoire. Children at all ages used only about 25% of the total possible number of combinations of facial elements; though the younger children tended to display 'neutral' facial expressions more often than the older children. Briefly, the younger children were less facially responsive than the older children, and spent much of time simply looking about with a neutral facial expression. In summary, the results of this study indicate that the potentially available social information in facial expressions increased with age.

There are several plausible causal and functional explanations for the results of this study, only four of which will be briefly outlined:

1. Grant (1969), Tomkins (1962), and others have conceived of facial expressions as displays which reflect internal motivational states or emotions. Thus for example, "smiles" may be indicative of happiness, while "lips pressed together" may be indicative of aggressiveness. The larger repertoire of the

older children in this study might be the result of two factors: (a) an increased differentiation of internal (motivational) states, and (b) an increased ability to blend these states (Ekman et. al., 1972).

2. Although the muscle movements that form the elements of facial expression are primarily determined by pre-cortical brain structures (Chevalier-Skolnikoff, 1973), there are also cognitive aspects to the display of these expressions. One of these aspects is what Ekman (1969) has called the display rules of facial expression and of facial masking. These cognitive rules control facial expression in accordance with cultural and idiosyncratic conventions. As the child develops, he becomes capable of comprehending and assessing the greater complexity and subtlety of social and non-social situations. This ability to "analyse" a social situation must certainly influence which facial elements are displayed and the circumstances under which they are combined. Thus, the age differences found in facial expression in this study may reflect the older children's more differentiated and sophisticated understanding of their world.

3. The complexity of the three-year olds' expressions did not vary according to social context; this was not the case with the older children. One possible explanation is that due to the physical growth of the face and skull, the buccal pads of the face diminish in size between the ages of three and five (Blurton Jones, 1972). This change may make it physically easier for the older children to form more complex facial expressions.

4. A functional explanation of this study's findings can be found in Bowlby (1969) and in Marvin (1972). As the child's attachment behavior declines over the years three through five, behavior systems functionally equivalent to mother's protection should develop to protect the child from conspecifics, and to facilitate the child's integration into the peer-peer social world. Marvin (1972) proposed that increased intraspecific communication skills could constitute one of these functionally equivalent behavior systems. In the present study the older children both spent more time in social contexts, and displayed increased complexity, faster rates of expression, etc. However, the amount of time actually spent in the social context did not account for these changes in facial expression. The results of this study, therefore, were consistent with Marvin's functional explanation.

SUMMARY

Nine children at each of three, four and five years of age were videotaped as they participated in free play. Their behavior was also judged as being solitary, semi-social, or social. Facial expressions of the children were later analysed from the videotape in a frame-by-frame analysis. Facial expressions were coded using a modification of Blurton Jones' facial expression catalogue. Approximately 800 codes per age group were collected.

Overall rates of facial expression were found to increase with age. All age groups spent about 50% of their time in the semi-social context. The three-year olds spent little time in the social context, while the five-year olds spent little time in the solitary context. When context was held constant, rates of facial expression increased with age.

The number of distinct facial expressions was found to increase with age. There was an increase with age in the number of different facial expressions that were required to account for 50% of all facial expression. Of the ten most frequently occurring expressions, at least 7 were identical at each age. Although neutral facial expressions were the most frequent at all ages, they were much more frequent in the younger age groups.

The complexity of a facial expression was defined as the number of elements in that expression. Mean complexity increased with age and there was a consistent difference between the

three-year olds and the older children in all contexts. In the social context, children of all ages smiled more than expected by chance. A number of causal and functional explanations of these findings were considered.

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